THE GHOUT OF SOUF: AN ORIGINAL HYDROAGRICULTURAL SYSTEM

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Abstract

This article deals with the subject of the Ghouts; an old hydro agricultural system of origin of the valley of Souf which, today is in distress. Hundreds of Ghouts were flooded by the waters of the lift and backfilled. Work missions were carried out in the oases of Souf during the period 2007-2017 to try to understand the decline of this heritage. Unfortunately it is the waters from the Albian aquifer of the Continental Intercalary and the sanitation that is the main cause of the decline of the Souf Ghouts.

Keywords: Water, Souf, Ghout, Palm, Oasis

1 INTRODUCTION

The Sahara, an immense desert with an area exceeding 9 million km^2 is considered the largest desert on the planet. A hyper-arid region characterized by the scarcity of rainfall and very high temperatures. However, the aquifer that stores the water infiltrated into the soil is the only reservoir of freshwater in these arid regions. For centuries, the local population has become infested in the search for better groundwater abstraction methods. Taking into account the geological and hydrogeological conditions of each region of the Sahara, water storage techniques have been highlighted. In the Saoura valley, for example, multi-rocker wells called Khottara have been designed to improve flow rates since [1]. In the oases of Touat, Gourara and Tidikelt, it is the draining galleries of a hundred kilometers called foggaras that were dug on the outskirts of Grand Erg Occidental [2][3][4][5]. In the Mzab valley, thousands of tensile wells have been dug to meet the needs for domestic water and irrigation [6][7]. In the Souf, a region located in the middle of Grand Erg Oriental. Surrounded by huge sand dunes, the Soufis (local population) realized an original hydro agricultural technique that allows the palm to grow while keeping these roots in contact with water from the water table. Today, this original irrigation system is in critical condition, hundreds of Ghouts have been abandoned; thousands of palms have been asphyxiated. This article describes, from this new ancestral technique, the types of Ghouts and the causes of deterioration of the Ghouts.

2 REGION OF STUDY AND METHODOLOGY OF WORK

2.1 Location and characteristics of the study area

The study area is located in the Wilaya of El Oued, one of the main oases of the northern Sahara. Located 650 km southeast of Algiers (Figs 1 and 2), Oued Souf occupies an area of 44 km^2, and extends over 18 municipalities (El Oued, Bayadha, Robbah, Kouinine, Guemmar, Taghzout, Hassani Abdelkrim, Debila, Sidi Aoun, Magrane, Hassi Khelifa, Reguiba, Mihouensa, Oued Alenda, Ogla, Nakhla, Ourmes et Trifaoui).

2.2 Investigations and investigations

To understand the Souf's hydro-agricultural system, several missions were carried out in the oases of Souf during the period 2010-2017. Investigations have been conducted on a hundred Ghouts to understand the functioning as well as the causes of deterioration of these farming systems. In addition, surveys were conducted with farmers and owners of the Ghouts to identify the socio-economic problems encountered over the last thirty years. The agricultural services (Agriculture Department of the El Oued wilaya) and hydraulic services (El Oued Hydraulics Department) provided us with data on the Ghouts.

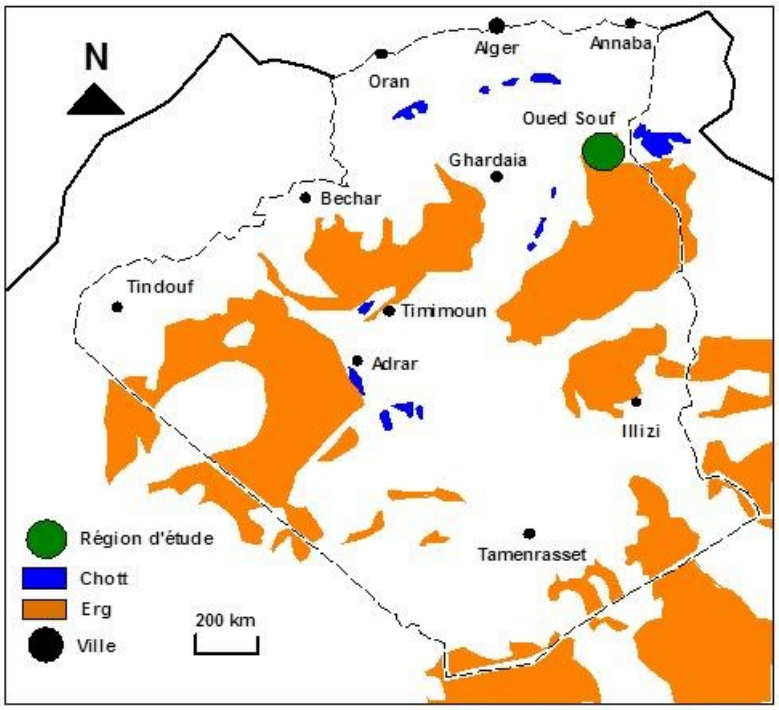

Fig. 1 Situation of the study area (own elaboration)

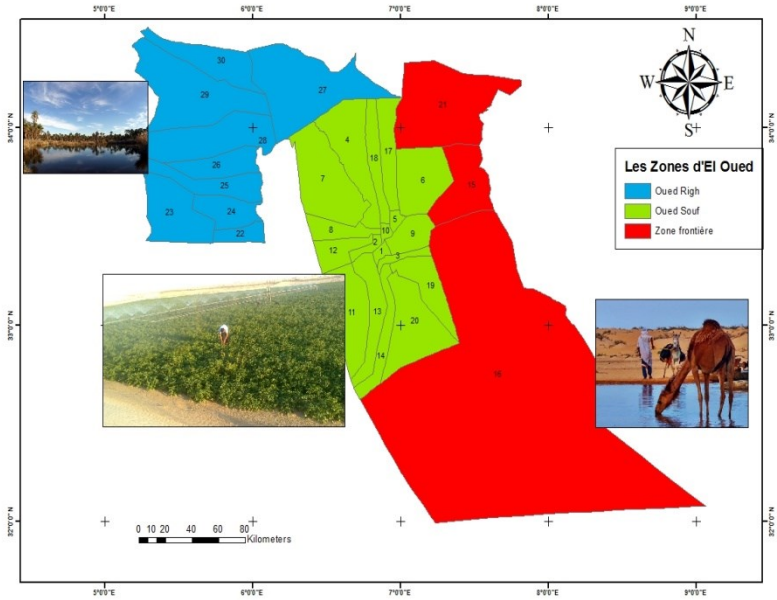

Fig. 2 The study areas of El Oued (own elaboration)

1 - El Oued 2 - Kouinine 3 - Bayadha 4 - Guemar 5 - Debila 6 - Hassi Khalifa 7 - Reguiba 8 - Taghzout 9 - Trifaoui 10 - Hassani A - Karim 11 - Oued El Alenda 12 - Ourmes 13 - Mih Ouensa 14 - Robbah 15 - Taleb El Arbi 16 - Douar El Maa 17 - Magrane 18 - Sidi Aoun 19 - Nakhla 20 - El Ogla 21 - Ben Ghecha 22 - Sidi Amrane 23 - M'Rara 24 - Djamaa 25 - Tendla 26 - Sidi Khellile 27 - Hamraia 28 - El Mghair 29 - Oum Tiour 30 - Still

3 RESULTS AND DISCUSSIONS

3.1 Features of the Ghout

The Ghout is a basin dug between the sand dunes of the Grand Erg Oriental, inside which a hundred palm trees are planted (Fig. 3). It is the Remal (the one that removes the sand). The bottom of the funnel must be above the static level of the water table with a height of 1 m. In this case, the plant will be irrigated only the first months, but beyond about 6 months the young palm tree does not bring irrigation water, but the palm tree itself will seek this amount of water by drawing water by its own roots.

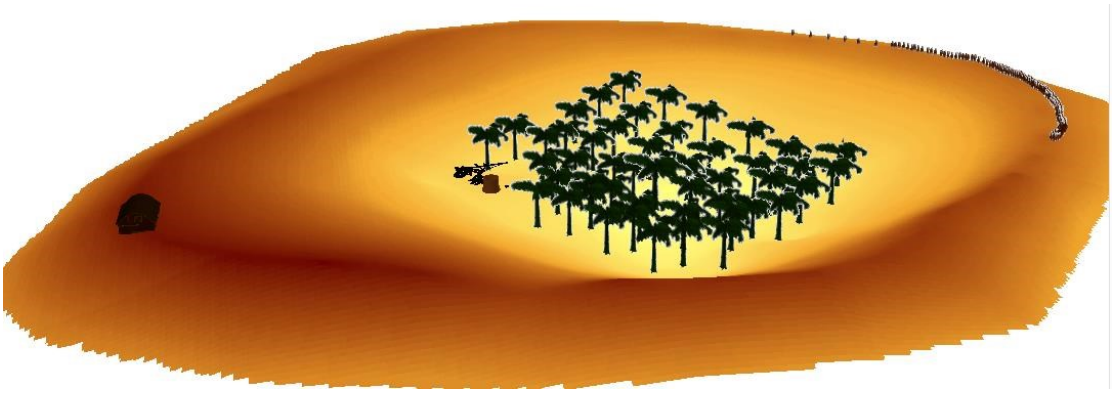

Fig. 3 The general outline of a Ghout of the Souf region (own elaboration)

Based on the latest inventory of Ghouts made in 2015 by the director of agricultural services of the Willaya of El Oued, a distribution of Ghouts throughout the Souf region was carried out (Fig. 4). This distribution of the Ghouts gives an idea on the situation of the tablecloth.

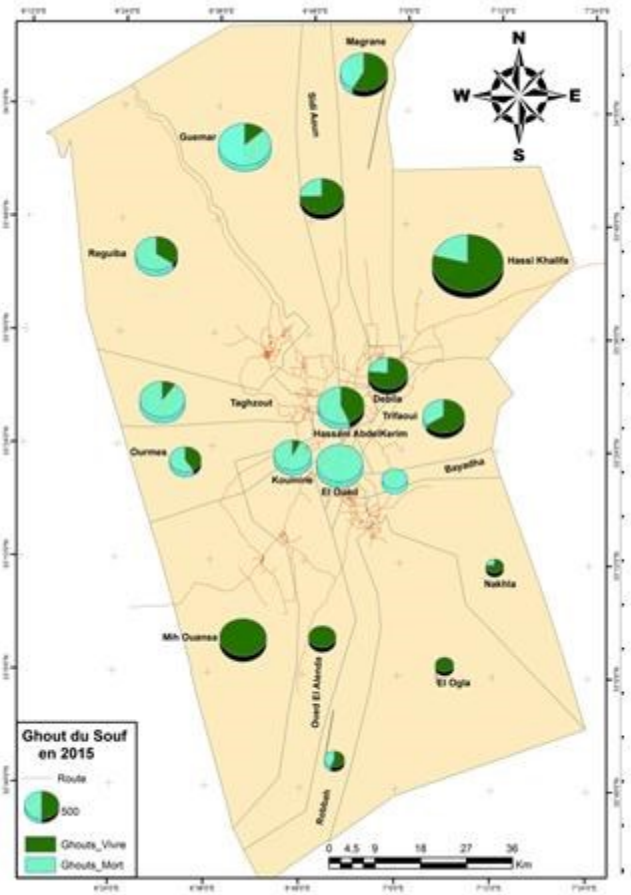

Fig. 4 The distribution of the Souf Ghouts according to 2015 inventory (DSA data, own elaboration)

3.2 The shapes of the Ghouts and their protections

The shape of the Ghout depends on the nature of the soil and the direction of the wind. There are three types of Ghout:

3.2.1 Circular Ghout

This type of Ghout is made in a windy area. It is located in the southwestern part of the Souf (Mih Ouensa, Oued Turk ... etc.) (Fig. 5). This region of the Souf, the level of the water table is shallower and is between 5 to 10 m. This region is characterized by:

- sandy soils,
- strong wind erosion,
- lively dune system,

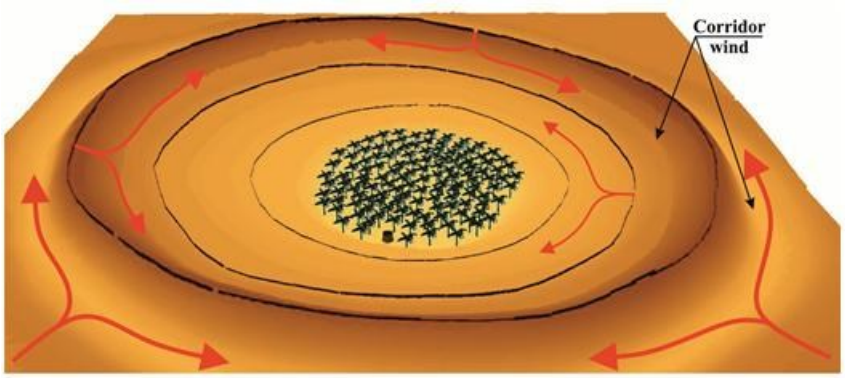

Fig. 5 Synoptic diagram of a circular Ghout (own elaboration)

In these areas, the winds blow in all directions. They are harmful to the fruits of the palm tree. Generally these Ghouts have the shape of a circular funnel. This type of Ghout requiers vaste espaces (Fig. 6).

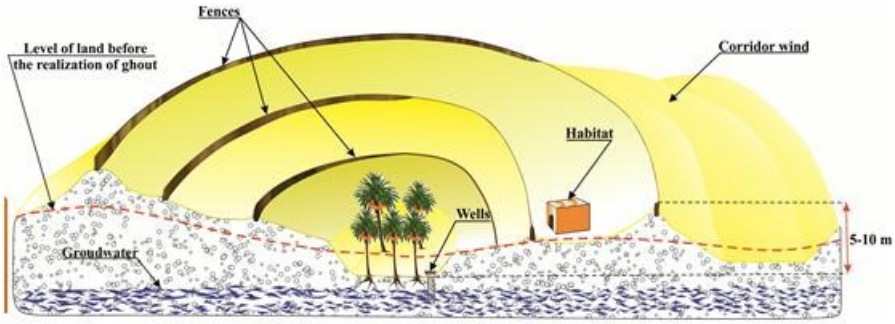

Fig. 6 Coupe a circular Ghout [8] (improved by the authors)

3.2.2 Elongated Ghout

This type of deep and elongated Ghout is found in the south and south-east of the Souf namely the oases: El Oued, Nakhla, Robbah, Bayadha. This type of Ghout is realized in a sandy area. These areas are characterized by very loose, sandy soils (Fig. 7 and 8). This type of Ghout has large size of an area equal to 1.5 to 3.5 ha; it can reach even 5 ha. A Ghout has an average of 100 to 200 palm trees. Excavation work on these large developments is enormous. This megaproject is done in a collective way. Usually 2 to 4 families or 5 to 10 farmers participating in the work. Ghout is shared among farmers according to the contribution of each.

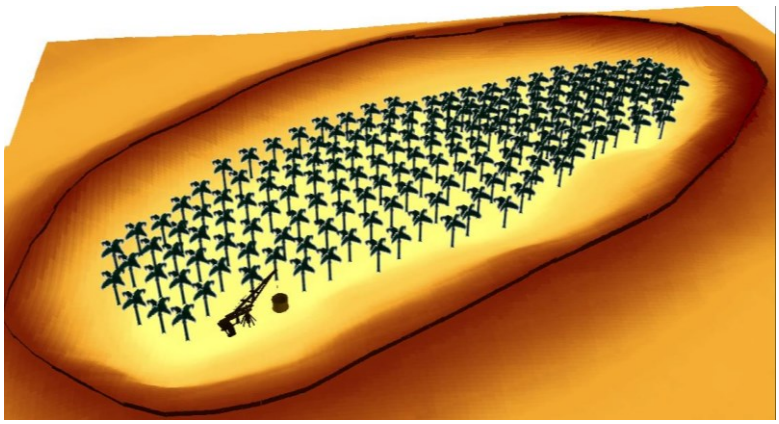

Fig. 7 Synoptic diagram of a Ghout of a sandy area (own elaboration)

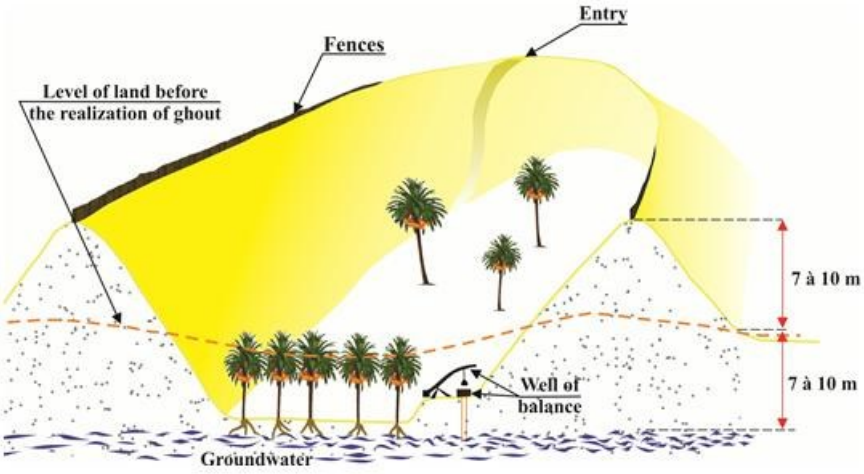

Fig. 8 Coupe of an elongated Ghout [8] (improved by the authors)

3.2.3 Rectangular Ghout

Built on a compact and clayey area, this type of Ghout is located in the northern part of the Souf: Hassi Khalifa, Magran, Hassani A-Kerim, Reguiba (Fig. 9 and 10). In these areas, this type of Ghout is realized in a clayey area. For this type of Ghout, the rectangular shape. Unlike other types of Ghout, this guy does not have palisades (Zarb).

Fig. 9 Diagram of a rectangular Ghout (own elaboration)

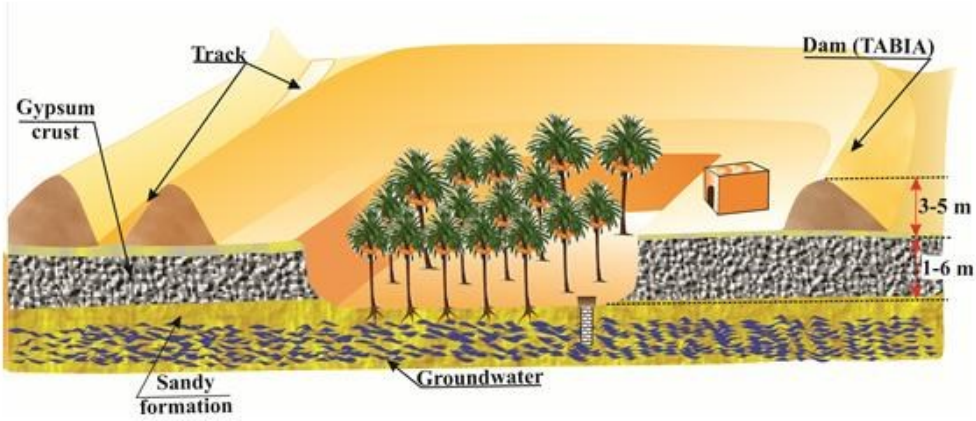

Fig. 10. Section of a rectangular Ghout [8] (Modified by authors)

4 WATERING TECHNIQUE IN THE GHOUTS

Destined for family consumption, a secondary crop behind the palm tree, the Ghout is equipped with a pendulum well for irrigation of gardens and young palms (Fig. 11). This type of well is everywhere in the village in the Ghouts and even in the middle of the dunes. In certain regions of Souf, the animal-drawn well was made by the Sufis (Fig. 12).

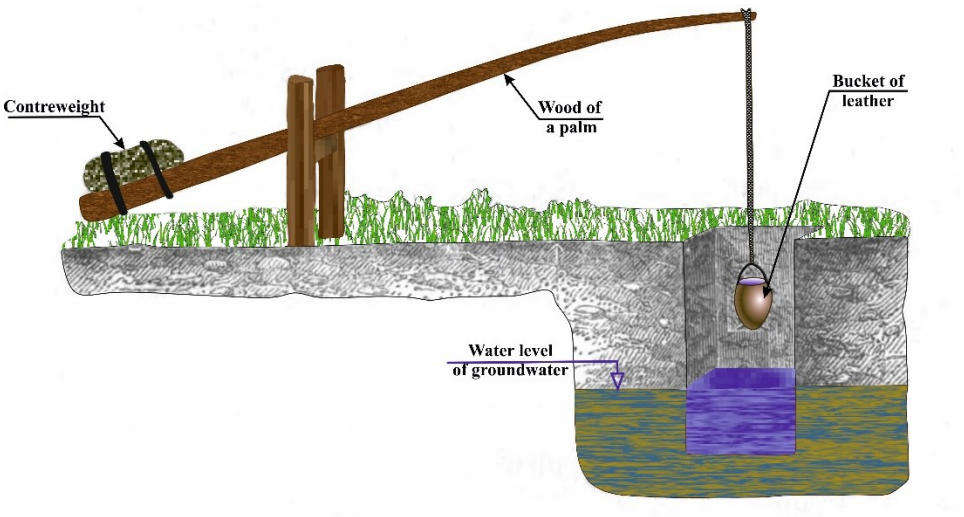

Fig. 11 Pendulum (Ghôtara) for irrigation in Ghout (own elaboration)

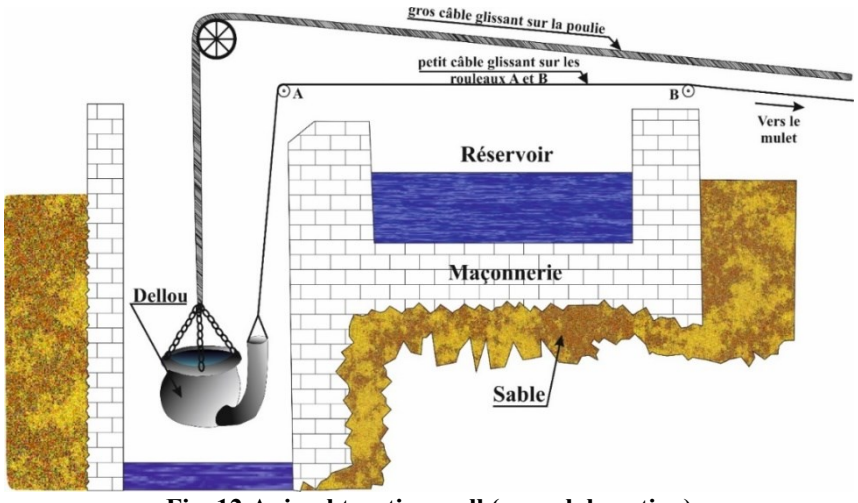

Fig. 12 Animal traction well (own elaboration)

5 THE DECLINE OF THE GHOUTS

The aquifer of the Continental Intercalary was a misfortune for the Ghout. In the early nineties this huge water reservoir was exploited by several deep drilling. Thousands of hectares of new land have been developed that require modern water harvesting techniques. It is a well as deep drilling was carried out for the water supply of the city of El Oued for irrigation. Following this very thorough irrigation, the water table could no longer withstand the return of irrigation water. This new situation caused flooding of the Ghouts. Mixed with sanitation water (lack of sanitation network), thousands of palms were asphyxiated leaving their places with reeds (Fig. 13). Dramatic adverse consequences have been recorded during this period: Pollution of the water table, flooding of the drowning Ghouts of the children in the craters of the Ghouts (Fig. 14), profuse mosquitoes [9][10][11][12][13].

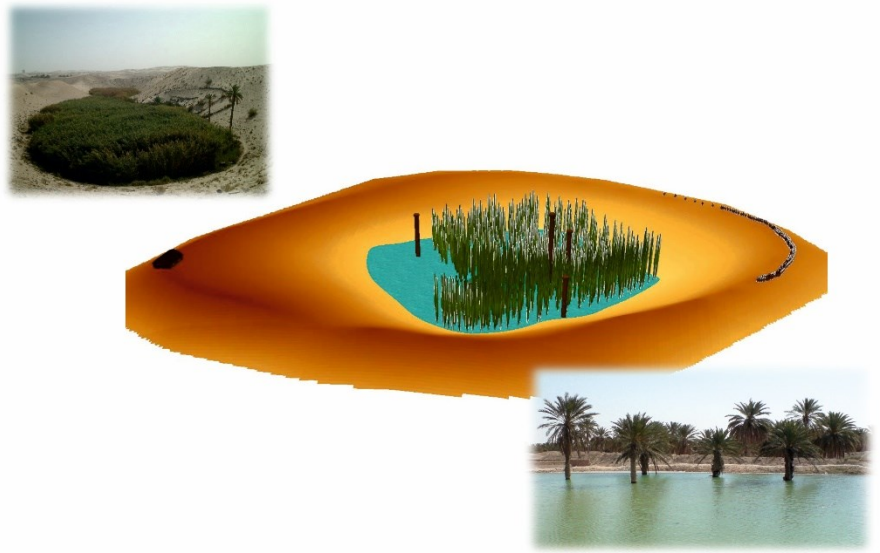

Fig. 13 Inundation of the Ghouts by the waters of the ascent of the tablecloth during the 90s (own elaboration)

Fig. 14 Ghout flooded by the waters of the tablecloth phreatic: dangerous bathing for children (photo. Miloudi, 2009)

6 WHAT SOLUTION TO SAVE THE SOUF A REGIONAL ECOLOGICAL CRISIS

For containment of the phenomenon of the rise, a mega-project was launched by the Algerian government in the early two miles. The goal is to clean up the sewage and drain excess water to evacuate to the Chott bordering Halloufa 45 km north of El Oued. Collective sanitation of collecting and transferring wastewater to the treatment plant for large agglomerations. Then for drainage, the principle is to recover all the seepage under the Greater El Oued by pumping in 58 drillings. Much of this water these waters will be used for irrigation of green areas. The purified water will be pumped to a length of 45 km to the discharge point of Chott of Halouffa.

7 7. CONCLUSION

As we mentioned at the beginning of this article, Ghout is a hydro agricultural technique originating from the Souf region. A very simple and ingenious system that involves digging in the Grand Erg Oriental craters to plant palm trees. Without irrigation, but the roots of the palm are continually in contact with the water table. Extraction of deep water by deep drilling for irrigations of irrigation and supply of drinking water causes a rise of the waters of the water table thus causing the flooding of the Ghouts. Several solutions have been applied but without results. This prompted the authorities to implement a mega project to stem the problem of rising water and its effects.

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